Public Engagement for Dynamic Governance of Research and Innovation

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Public Engagement for Dynamic Governance of Research and Innovation

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Abstract: Public engagement (PE) has become an important theme of research and innovation (R&I) activity in several countries. In Europe, which is the main focus of this paper, the European Commission – by setting PE as a key thematic element of its policy for responsible research and innovation (RRI) – has promoted fundamental changes in the ways that civil society and other stakeholders outside the scientific community influence, and are expected to influence research activities. Promoting PE means giving more weight to citizens and stakeholders in the definition of research needs, in the critical reflection of current and future research priorities, and in the implementation of R&I activities. In this paper we analyse the trends and characteristics of innovative PE based on a recent international study of such processes, and discuss how PE can contribute to more dynamic and responsible governance of research and innovation.

Keywords: Public engagement; dynamic governance; responsible research and innovation; fourth sector; trend analysis; PE footprinting method; success; obstacles.

1 Introduction

Public engagement (PE) has become an important theme of research and innovation (R&I) activity in several countries. In Europe, which is the main focus of this paper, the European Commission – by setting PE as a key thematic element of its policy for responsible research and innovation (RRI) – has promoted fundamental changes in the ways that civil society and other stakeholders outside the scientific community influence, and are expected to influence research activities. Promoting PE means giving more weight to citizens and stakeholders in the definition of research needs, in the critical reflection of current and future research priorities, and in the implementation of R&I activities. Yet there is limited understanding of the transformations that widespread use of PE will involve in R&I activities. Can PE remain an add-on to research and innovation activities, or does it involve some new functions, or even structural changes in the ways that research will be designed, funded, implemented and evaluated? How can PE contribute to a better governance of science-in-society interaction, and what makes it successful in it? Without clear answers to these issues, there is a risk that PE does not serve RRI, but on the contrary, becomes a burden for R&I activities, and an obstacle for bridging of research and society.

The paper will focus on the problem of how PE, as increasingly requested by public research funders, can positively contribute to dynamic and responsible governance of R&I. The paper contributes to this discussion by summarizing the key findings of recently ended, EU-funded project 'Public Engagement

Innovations for Horizon 2020' (PE2020) project.[1] The project identified, analyzed and refined innovative PE tools and instruments for dynamic and responsible governance of R&I, and elaborated a conceptual framework of PE, where innovativeness, participatory performance and dynamic governance are the key components.

Previous research has pointed out that there are both knowledge based, practical and democratic rationales to promote PE in research and innovation (e.g., Fiorino, 1990; Rask et al., 2015). This is reflected in EU's RRI policies that request research performing agencies to increasingly integrate PE throughout the research cycle. National research funding agencies have also introduced new criteria that reflect this thinking. Several academic studies, however, have paid attention to the limited impacts of PE, and criticized it from the tendency of remaining marginal activity (e.g. Grönlund et al., 2014; Kies and Nanz, 2013; Rask, 2013; Goodin and Dryzek, 2006; Rip, 2003).

Reviewing the key results of a recently ended international project on PE, we will discuss in this paper how innovative PE can contribute to more dynamic and responsible governance of research and innovation. The paper is structured as follows. In the next section we will define the research questions that also guide the logic of this paper. In section three we will explain the data and methods applied. The results are presented in Section four. In the last section we will discuss the findings, and focus on the practical implications, including opportunities for making such methodological and strategic choices that help developing more dynamic and responsible strategies for governing research and innovation activities.

2 Research question

Contributing to the discussion on the actual and potential role of PE for more dynamic and responsible governance of R&I, the goal of this paper is to answer to the following research questions:

1. What are the trends and characteristics of innovative PE in the field of research and innovation?
2. How does innovative PE contribute to new governance practices, new knowledge, and more democratic R&I processes?
3. What new capacities are created through PE processes?

4. What are the successes and limitations of innovative PE?

Finally, we will discuss the practical implications of the findings. In particular, we will propose some methodological solutions and strategic choices that may help both public sector (e.g. research managers and funders) and private sector (e.g. corporate social responsibility managers, technology developers) actors govern their research and innovation activities in a more dynamic and responsible way.

3 Data, research design and methodology

3.1 Data

Our data are based on descriptions of 38 innovative PE cases, selected from a global sample of 256 cases that were identified in the data basis of the MASIS[2] and Engage2020[3] projects, a systematic literature review, and our own qualitative survey. These cases are real-life initiatives that were realized (some of which still on-going) between 1992-2016 in Europe and the United States and are based on engaging the public in research and innovation activities. Full descriptions of the cases can be found in Ravn and Mejlgaard (2015). The identities of the cases are described in *Table 1*.

Table 1 Identities of the 38 innovative PE cases

N	Title	Coordinator	Year	Type
1	PRIMAS	University of Education Freiburg, Germany	2010-13	Project
2	Science Municipalities	Danish Science Factory	2008-11	Programme
3	Nanodialogue	Fondazione IDIS – Città della Scienza	2005-07	Project
4	Breaking & Entering	University of Copenhagen	2013-14	Project
5	EARTHWAKE	EUROSCIENCE	2007	Project
6	Let's do it - movement and world clean up	Let's Do It Foundation	2012-18	Social movement
7	DEEPEN	Durham University	2006-09	Project
8	Flemish Science Shops	Vrije Universiteit Brussel and Univ. Antwerpen	2003-ongoing	Programme
9	RESEARCH2015	Ministry for Science, Technology and Innovation	2007-08	Project
10	iSPEX	iSPEX consortium	2013-ongoing	Project
11	PERARES	Living Knowledge Network	2010-14	Project
12	SpICES	Atomium Culture	2012-13	Project
13	The Autumn Experiment	Vetenskap & Allmänhet	2013-14	Project
14	VOICES	Ecsite	2013-14	Project
15	Societal Advisory Board	JPI More Years Better Lives	2012 – Ongoing	Org. entity
16	Imagine Chicago	Imagine Chicago	1992-94	Project
17	Bonus Advocates Network	BONUS programme	2010-11	Programme
18	Owela Open Web Lab	VTT, Technical Research Centre of Finland	Ongoing	Service
19	Citizens' Dialogue on Future Technologies	German Ministry of Research and Education	2011-13	Project
20	GenSET	Portia Ltd	2009-12	Programme
21	Law no. 69/07 of the Tuscany Region	Tuscany Region	2008-13	Legal framework
22	Act Create Experience	WWF-UK	1996-ongoing	Programme
23	The National DNA Database on Trial	University of South Wales	2008-09	Project
24	2WAYS	European Science Events Association, Eusea	2009-10	Project
25	NanoDialogue	German Min. of Env., Nat. Cons. & Nuclear Safety	2006-ongoing	Programme
26	World Wide Views on Global Warming	The Danish Board of Technology	2007-09	Project
27	Bioenergy Dialogue	Biotech. and Biological Sciences Research Council	2012-14	Project
28	Soapbox Science	Dr Seirian Sumner & Dr Nathalie Pettorelli	2011-ongoing	Programme
29	Futurescape City Tours	Consortium for Science, Policy & Outcomes	2012-14	Project
30	CIVISTI	Danish Board of Technology	2008-2011	Project
31	Empowering Citizen Voices in. New Orleans	America*Speaks*	2006-07	Project
32	Consensus Conference on future energy	Wissenschaft im Dialog gGmbH	2010	Project
33	Peloton	Demos Helsinki	2009-ongoing	Programme
34	PARTERRE	Tuscany Region	2010-12	Project
35	Imagine Jersey 2035	States of Jersey and Involve	2007-08	Project
36	G1000	G1000	2011-12	Project
37	Youth Council Espoo	City of Espoo	1997-ongoing	Org. entity
38	We the Citizens	University College Dublin	2011	Project

3.2 Research design

Data were analyzed to explore the trends and characteristics of innovative PE processes, and to conceptually model how PE can contribute to dynamic and responsible governance of R&I. Data were analyzed both from quantitative and qualitative perspectives.

Quantitative analysis included conventional statistics of the communication patterns, participant selection methods, PE approaches and mechanisms, impact areas, learning and continuity, and features of innovativeness of the 38 selected cases. Full results of these analyses can be found in Rask et al. (2016).

Qualitative analysis included a comparative content analysis of the PE case descriptions. We observe that the PE processes studied were highly complex in nature, as they are based on abundant collaborative practices among different players, where the border between core and periphery functions is difficult to discern. We therefore tailored a new methodological approach, 'PE footprinting', to help analyzing such cases. The method was semi structured, and we will explain it more detailed in the next subsection, as it may prove to be useful approach in future analyses of complex collaboration processes and their impacts.

3.3 The 'PE footprinting' approach

The 'PE footprinting' approach that we developed for the analysis of complex PE processes, was the analytical backbone of our study (Rask et al., 2016). The method was semi-structured, including some pre-defined categories of input, throughput and output, while new categories were added based on the comparative analysis of cases. Thus the analyses of socio-policy impacts, for example, included pre-defined dimensions based on literature analysis, such as participant learning, impacts on policy making, media coverage, creation of new knowledge and products, while new categories such as institutionalisation, enhanced civic capacities, empowerment, mutual benefits, cultural change, community building, democratization, societal change, and creation of professional networks were added as such impacts were repeatedly identified in the studied cases. A complete collection of the 38 fooprinted PE processes can be found in Rask et al. (2016). An example of a studied PE footprint is in *Figure 1*.

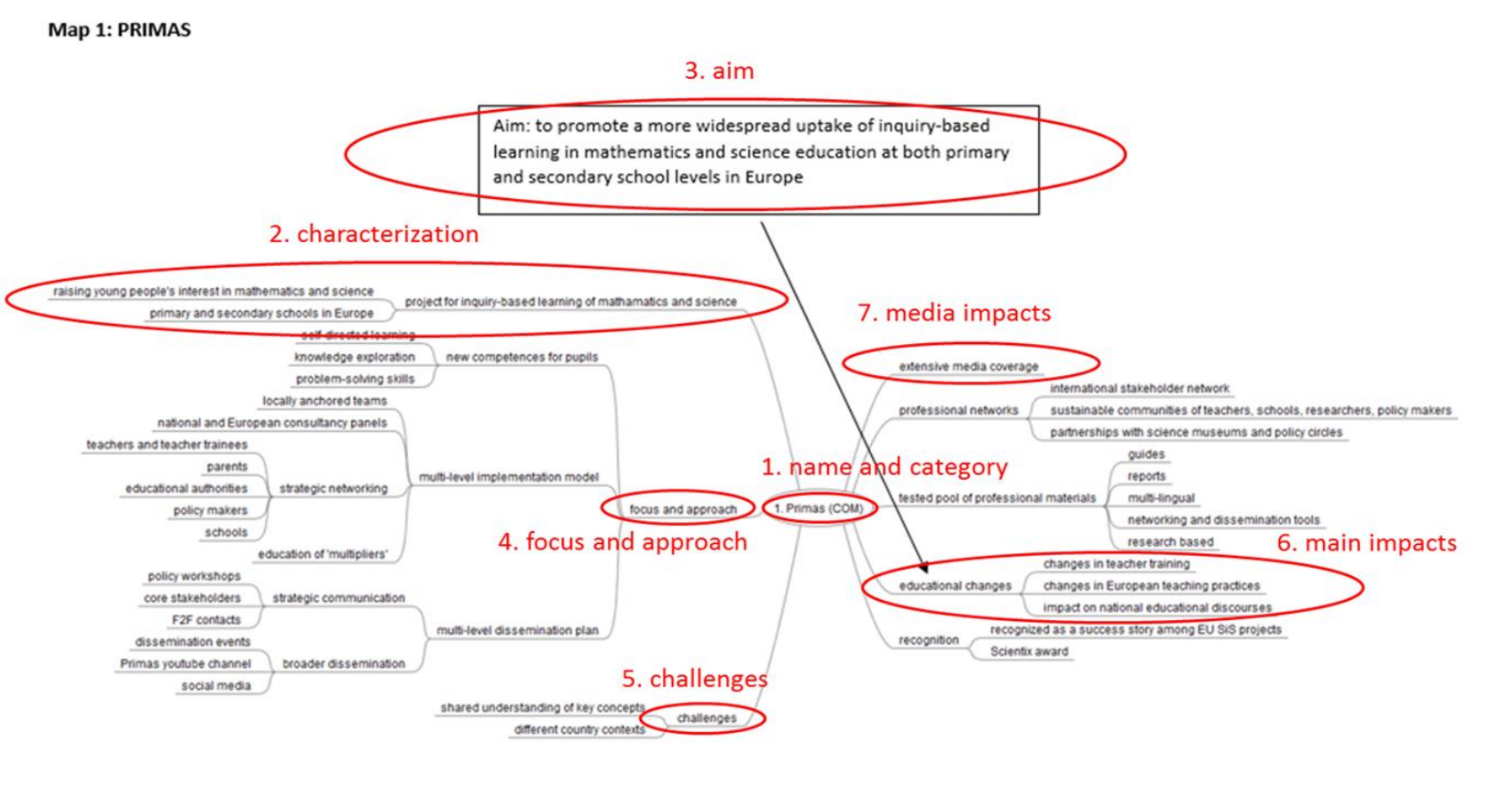

Figure 1 An example of 'PE footprint' (Source: Rask et al., 2016)

The preparation of 38 footprints of innovative PE processes didn't only help to capture the 'essence' of each case, and illustrate how their intended aims corresponded with the main impacts achieved, but also making comparative analysis of the characteristics of such cases. For example, we could see that close to half of innovative PE processes enjoyed high media publicity, which is welcome news for the efforts to democratize the development of R&I, as publicity is often considered a necessary requirement for well-functioning democracy (e.g. Dryzek, 2000).

4 Findings

In this section we will report the main findings of our study in regard to the four research questions of this paper. Section 4.1 will focus on the trends and charasteristics of innovative PE, Section 4.2 on the substantive, practical and normative impacts, Section 4.3 on new capacities developed through PE, and Section 4.4 on the successes and limitations.

4.1 Innovative PE – trends and characteristics

Our analysis focused on innovative PE processes – not on established PE procedures, such as focus groups and public hearings. We were interested in studying innovative PE practices, since there is a high potential in them, in solving some of the stubborn problems of R&I governance, including inadequate resources to conduct research on urgent problems and challenges, low societal acceptance of technological solutions, limited public awareness of technoscientific development, and limited democracy of R&I decision making. Following these considerations, we defined innovative PE as new participatory tools and methods that have the potential to contribute to a more dynamic and responsible governance of R&I.

In order to identify innovative PE tools, we drafted a 'preliminary definition of innovativeness' that was based on the following characteristics, based on our previous understanding of the state-of-the-art in this field: a) new ways of representation, b) methodological and institutional hybridity, c) bearing to political impacts and d) focus on societal challenges. These characteristics were used as a means to select innovative PE cases for a closer study.

We next report our findings on the trends and characteristics of the cases studied in terms of the following dimensions: actors involved, methodological orientation, and the nature of the issues or problems discussed.

Increasing representation of the third and 'fourth sector'

We found that innovative PE processes are mostly initiated by non-profit organizations such as NGOs, unofficial networks and associations (*Table 2*). Research institutions were the next frequent promoters of PE, followed far behind by national governments and other types of institutions.

Table 2 Types of promoters of innovative PE processes (Source

Type	No.
Non-profit organisations	14
Academic institutions	10
National governments	5
Networks	5
Local governments	3
Other	1
Total	**38**

Characteristics to innovative PE is that they involve a high number and variety of different types of actors. Typical actors included researchers both from public and private research institutions and public authorities regulating or funding research. We also found that the social sector, sometimes referred to as the 'third sector', was involved in most cases. None of the cases were based merely on expert representation, by involving only scientists or policy makers. One-fifth of the cases involved only stakeholders. Our findings thus confirmed the trend of an increasing representation of the third sector through the participation of organized stakeholder groups, such as environmental and industrial organizations, in many areas of R&I governance (e.g., university boards and national research and innovation policy councils), as identified by previous studies (e.g., Rask et al., 2012).

More strikingly, we found that three-quarters of the innovative PE cases involved the so-called 'fourth sector'. There are several definitions of the fourth sector in the research literature. Sabeti (1998) refers to hybrid organizations, such as chaordic organizations,[4] social enterprises, cross-sectoral partnerships and

community interest corporations. Williams (2002) refers to the world of volunteering and 'one-to-one' helping amongst affluent and deprived people. Mäenpää and Faehnle (2015) refer to public activism outside organized interest groups, such as neighbor self-help groups, local movements, pop up restaurants and exhibitions, and small sized cooperatives. Common to all these notions is that the fourth sector is seen as an emerging field, composed of actors or actor groups whose foundational logic is not in the representation of established interests, but rather, in the idea of social cooperation through hybrid networking.

In our data, we found the fourth sector to be present through highly diverse actors, such as hybrid experts, randomly selected participants, 'life world experts' and 'field experts'. Various types of fourth sector participants in innovative PE processes are illustrated in Figure 2.

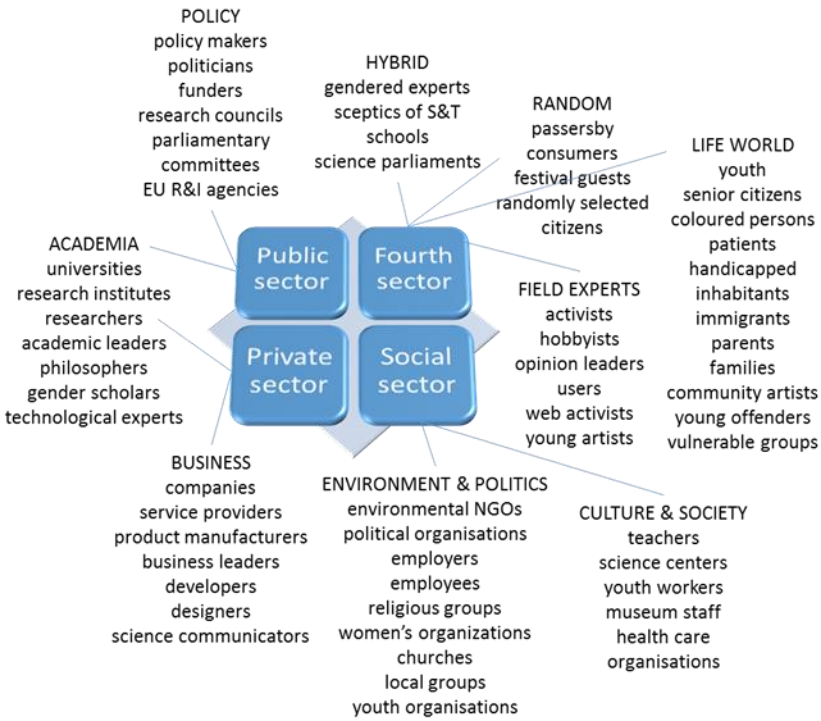

Figure 2 Four sectors represented in a sample of 38 innovative PE cases (Source: Rask et al., 2016)

Orientation toward multiple-way communication and public deliberation

As for the methodological approaches applied, we analyzed the cases in terms of the following five methodological categories:

- *Public communication* – the aim is to inform and/or educate citizens
- *Public consultation* – the aim is to inform decision-makers of public opinions on certain topics.
- *Public deliberation* – the aim is to facilitate group deliberation on policy issues of where the outcome may impact decision-making.
- *Public participation* – the aim is to assign partly or full decision-making-power to citizens on policy issues.
- *Public activism* – the aim is to inform decision-makers and create awareness in order to influence decision-making processes.

The main finding was that there seems to have been a comprehensive turn from one-way communication processes toward multiple-way communications. Rowe and Frewer (2005) have characterized public communication and public consultation as 'one-way' communication processes, since in the former, information is expected to flow from the sponsors of PE toward the public, and in the latter the expectation is the opposite. In our sample we preliminarily included 18 PE processes in the category of one-way communication. Contrary to our expectation, however, we found that practically all PE cases – including studied public communication and consultation processes – were in reality based on two or multiple-way communication**.**[5] An illustrative example of the shift towards multiple-way communication is the *Nanodialogue* project. Its main aim (typically to a traditional science communication project) is to increase public awareness of nanotechnologies by raising curiosity and stimulating public debates on topical scientific issues. In reality, in however, the *Nanodialogue* project was a multidimensional communication exercise, where a transdisciplinary group of philosophers, designers, politicians, social scientists, nanoscientists and members of the museum staff first co-designed the PE process; then they organised dialogues with families, schools, nanoindustries and science centres, which finally led not only to increased public awareness of nanotechnology but also to a transformation of science centres' conception of their own roles in the business of science communication (from a spectator of scientific development to its active supporter). It would be a violation of the reality to label such activity as one-way science communication, since not only

the public was targeted through educational efforts, but also the organising bodies whose identities were under revision.

Another important finding was that 'public deliberation' was the most frequently used approach. Compared to more traditional models of public communication and public consultation, where dialogue between decision makers and the public is narrow and restricted, public deliberation represents a more active model of SiS activity. We consider the prevalence of deliberative processes to be an indicator of the increasing methodological maturity of the PE field, as the development in this respect seems to be moving toward the direction that scholars of participatory processes have recommended for several decades (e.g., Gastil and Levine, 2005). An intensifying resonance between the theory and the practice of PE can, in turn, increase the robustness, credibility and relevance of methodological development, and help to consolidate the whole field of PE by providing scientific evidence to the business of renewing governance practices.

Focus on societal challenges and systemic change

We also analyzed the PE cases in terms of their focus on the types of societal issues that they approached. We found that the tendency was clearly toward broadly defined societal challenges rather than narrowly defined problems or technical solutions. Except for one case, all innovative PE cases were oriented towards addressing societal challenges. *Europe in a changing world – inclusive, innovative and reflective societies* was the most frequently addressed challenge among the EU's seven societal challenges,[6] whereas *Secure societies – protecting freedom and security of Europe and its citizens,* and *Smart, green and integrated transport* attracted less attention.

While the challenge-driven approach has obvious virtues, as acknowledged by high level European strategies, there are also "challenges in addressing grand challenges," as professors Stefan Kuhlman and Arie Rip (2014) claim in their 'think piece'. The main challenge according to the authors is that addressing societal challenges involves an open ended mission and requires systemic transformations. This is in contrast with more traditional R&I policies that focus on stimulating innovations in particular technological domains through dedicated funding programs. To address societal challenges better, Kuhlmann and Rip (2014) have called for a 'tentative governance' approach, which includes ideas that governments should adopt a facilitative role in a) orchestrating activities by

a high variety of actors by creating new spaces for interaction – and actively involving new actors such as charitable foundations, which can operate with fewer bureaucratic and democratic constraints, b) supporting experimentation through dynamic, provisional and revisable interventions, and c) facilitating systemic change through tentative policy mixes.

Overall, we found that innovative PE processes contributed to systemic change in several ways. Such ways included conceptualisation. *Science municipalities* (*Table 1*), for example, contributed to the notion of 'science municipality', while it also developed related infrastructure. Other examples of new concepts that were developed include 'science parliament (*2WAYS*)' and 'long-term participatory foresight' (CIVISTI). Another way to facilitate systemic change was by building new competencies. *PRIMAS*, for example, focused on the promotion of inquiry based learning at both primary and secondary schools in Europe. New socio-technical solutions were developed under several initiatives. Examples are *DEEPEN*, that developed solutions on how to govern a new domain of science (nanotechnology) under conditions of uncertainty, while enhancing innovation and remaining sensitive to public concerns. Resulting from this process was a new 'upstream' methodology that helped informing the EU's RRI policy about issues of nanotechnology. *Peloton* is another interesting case that developed an innovative way for citizens to participate in the co-creation of new products and services – and also contributed to the notion of 'smart-up'. Demonstration, finally, is a paradigmatic example on how systemic change was promoted under the notion of 'tentative governance'. *VOICES* aimed at demonstrating that citizens' ideas, preferences and values can be taken into account in defining agendas for European research and innovation activities (in the area of urban waste). *World Wide Views on Global Warming* demonstrated that global citizen deliberation is feasible. *PARTERRE* focused on demonstrating the business potential of two new e-participatory tools. In sum, contributing to systemic change was a prevalent characteristic of innovative PE.

4.2 High practical impacts, low substantive impacts

Contrary to some earlier studies, which have paid attention to the limited impacts of PE (e.g., Grönlund et al., 2014; Kies and Nanz, 2013; Rask, 2013; Goodin and Dryzek, 2006; Rip, 2003), we found innovative PE to have truly versatile impacts, not only on R&I but also on environment, society, politics – and individuals. We distinguished between three types of impact area – substantive, practical and

normative – and we found that close to three-quarters of the reported impacts could be described as practical.

Table 3 Share of different impact types in the studied PE processes

	Substantive	Practical	Normative
S&T issues	5 %	27 %	6 %
Societal issues	1 %	29 %	7 %
Political issues	2 %	15 %	7 %

The high proportion of practical impacts is an interesting finding, since there is much talk about the rationales of PE: should it be driven by democratic, epistemic or pragmatic motivations? Our empirical finding is that innovative PE largely produces practical goods, such as cognitive and attitudinal changes (e.g., better awareness of environmental and scientific issues), development of new capacities (e.g. new professional skills, methods and platforms of collaboration), and mobilization of resources for addressing scientific and societal challenges (e.g. research funding, political commitment, public awareness, and social acceptance).

However, this is not to say that other types of impacts should be of lesser value. Normative impacts, for instance, included benefits such as consensus building, community building, political empowerment, increased gender equality in science, and introduction of the principles of deliberative democracy to R&I governance. At best, PE processes oriented at such values can initiate a virtuous cycle of democratization of R&I, the logic of which is conceptually model in Figure 3.

Figure 3 A model of democratization of R&I through PE

The public engagement movement has roots in the late 1960s and early 1970s, when it was initiated as part of an overall movement in Western societies towards further democratization (e.g., Geurts and Mayer, 1996; Jamison 1999). The agenda of demoratizing research and innovations still seems to be there, and available for policy makers, even though there has been a shift toward more pragmatically orientated PE activities (*Table 3*).

Quite surprisingly, creation of new substantive knowledge was not among the core outputs of innovative PE processes. We found eight cases in which new substantive knowledge was mentioned among the outputs, and only two cases contributed directly to new scientific knowledge, including two citizen science projects, *Autumn experience* and *the Flemish citizen science project* that contributed to scientific measurements, building of data bases, publications in academic papers and related academic theses. A related contribution was the identification of new research areas, as in the case of the *Europe-wide citizen consultation VOICES* that organized a process of defining strategic research priorities with regard to urban waste research in Europe. Other substantive or epistemic impacts in the societal area included crowdsourcing of new ideas and revelations about consumers' preferences, and respectively in the political area, surveying of public opinion as well as study of regulatory implications.

4.3 New capacities introduced

We introduced the concept of 'participatory performance' to refer to the different functions of PE, and to the scope and intensity of PE activities. We analyzed how participatory performance contributed to new capacities of dynamic governance, including anticipation, reflection, transdisciplinarity and continuity.

Anticipation refers to the capacity for prospective thinking and acting. Anticipation of the future is among the core functions of innovative PE. This took place through participatory foresight activities and various collaborative processes identifying future research needs. Included in this group can also be so called 'upstream engagement' processes (e.g. *Deepen, Flemish science shops, PERARES, VOICES and the Tuscan Law No. 69/07*) that involve two-way communication at an early stage of the research or policy cycle, in contrast to downstream, in which selection instead of design is the key (cf. Joly and Kaufmann, 2008). Opening up the agenda setting stage to a public or stakeholder based scrutiny can help anticipating and addressing such societal concerns that may become activated at a later stage of the R&I cycle.

Reflection, in the context of our discussion, refers to the capacity to publicly accomplish critical reflective dialogues with relevant stakeholders, who can take the role of the other, develop shared values, and subject their reasoning to public scrutiny (cf. Raelin, 2001). Public reflection supports learning from past successes and mistakes, and it also helps building collective identities around focal themes and practices. Public reflection is also among the key concepts in the theory of deliberative democracy that promotes organising of public dialogues and deliberations around politically meaningful matters (e.g., Dryzek, 2010).

Public reflection on research and innovation is – by far – the most general function of innovative PE. While issues of R&I were the main subject of such debates, regulatory and policy issues were also frequently discussed. Different types of organised face-to-face discussions, events and workshop were the main participatory mechanisms used, while on-line tools were frequently used as supportive tools in close to half of the cases. Participants of the discussions involved experts and stakeholders, but increasingly also the 'fourth sector'.

Transdisciplinarity refers to the capacity of holistic thinking and acting by mobilizing knowledge, expertise and other epistemic resources across and

beyond scientific disciplines. Transdisciplinary studies is a flourishing field of research, with its own university programmes and training schemes. Engaging in a full discussion on different ways to understand the concept is beyond the scope of this paper, but we refer to Nicolescu's (2002) classic definition of transdisciplinarity, which refers to research activities that go between the disciplines, across the different disciplines, and beyond all disciplines. Ideas of holistically understanding the world and an underlying idea of the 'unity of knowledge' can also be found in literature (e.g., Klein, 2004).

Considering our data, transdisciplinarity is a widespread feature of innovative PE. Some two-thirds of the PE cases studied included at least some aspects of transdisciplinary, such as involvement of multiple disciplines in research efforts and challenge oriented definition of research priorities. As far as public engagement refers to the involvement of lay people or non-experts in R&I activities, transdisciplinarity is even a tautological characteristic of PE. Yet we can observe differences between the ways in which innovative PE expresses transdisciplinarity. We found that transdisciplinarity is more tightly linked to the realm of policy rather than to research; to the transgression of established actor groups rather than to the transgression of scientific disciplines. One obvious reason is, that our sample represents primarily innovative R&I governance practices, not innovative research practices. In line with this, most of the reported transdisciplinary activities included practically or normatively oriented functions, such as design of transdisciplinary research programmes, broad mobilisation of societal and financial resources for R&I activities and introduction of new public-private partnerships. Only in few cases we found instances of transdisciplinary research, for example in the citizen science project *iSpex* as well as in the two cases of science shop initiatives (*Flemish Science Shops, PERARES*).

Continuity refers to the capacity to embed new activities in existing institutions or otherwise building bridges between separate interventions. Continuity is needed to balance accelerated change caused by increasingly dynamic governance actions. Conversely, if discontinuity prevails between different interventions and events, this hinders organisational and institutional learning and limits the effectiveness of interventions as there is no accumulation of the effects. The need for continuity has been recognized in different streams of scholarly literature. 'Systemic turns' both in innovation studies (e.g. Smits and Kuhlman, 2004) and studies of deliberative democracy (e.g., Parkinson and Mansbridge, 2012; Dryzek, 2010) both emphasize the importance of managing

institutional interdependences and path dependences that can either support of hinder effective action.

PE, quite interestingly, is not in an arbitrary but in a dynamic relation with institutional continuity. On one hand, PE is often the change maker, by introducing new approaches to old governance dilemmas. Indeed, PE may create a social pressure to the organisation forcing it to go on with the policy cycle and may make the process more transparent and accountable, so that it cannot be arbitrarily stopped or changed without any consequences (in terms of reputation, credibility, trust, etc.). On the other hand, externally developed tools and methods of PE threaten to remain disjointed from the actual practice of policy making, for which reason particular efforts are needed to ensure their relevance in the long term.

Continuity was an important aspect of the PE processes studied. Continuity was related to the aims to institutionalise the use of PE tools in R&I governance, and in some cases, to the institutionalisation of the principles of deliberative democracy in R&I governance, which is actually a highly ideological project. Along with these tendencies, a major proportion of innovative PE processes have moved beyond a narrowly instrumental, methodological or event based approach. Instead, we have identified various types of 'boundary work' (Gieryn, 1983), including activities that aim to stimulate and manage interactions between institutions of different sorts, such as science centres, ministries and research institutes. As a consequence, innovative PE is not so much about providing researchers with new tools for effective science communication, but rather, contributing to new skills and capacities to collaborate across institutional borders. Examples include enduring professional networks and internationally distributed methodologies and guidelines that help expanding and consolidating PE practices.

4.4 Successes and limitations of innovative PE

Overall, we found that most of the cases of innovative PE studied could be classified as successful, both by the reporters and the analysts. This is no wonder, as we chose the cases to be most innovative ones, and that the data consisted of descriptions done by the coordinators of such processes.[7]

As innovative PE includes a highly diverse set of activities, applying a narrow model of evaluating success can therefore be too restrictive. To address this issue,

we studied the different ways in which the coordinators of innovative PE described successful action by themselves, and integrated such criteria with some more traditional criteria familiar from evaluation literature (for meta-evaluations of PE activities, see e.g., Beirle and Cayford, 2008; Dietz and Stern, 2008, for classic evaluation criteria, see e.g., Georghiou and Keenan, 2005). As a result, we developed a 'synthetic evaluation model' (Rask et al., 2016) that was composed of 38 criteria, measuring performance in terms of *appropriateness* (including sub-categories of appropriate goals and ethical quality), *efficiency of implementation* (including sub-categories of representativeness, organizational competence and methodological quality) and *impacts and effectiveness* (including sub-categories of institutional impacts, political relevance, practical impacts and substantial impacts).

While it is beyond the scope of this paper to delve into the details of the synthetic evaluation model, we recapitulate the definition of successful PE that reflects all the main criteria proposed (Rask et al., 2016, p. 20):

> *Successful PE involves right people with right methods and goals, while leaving a big 'footprint' on research, innovation and society.*

The single most important factor that contributed to the success of innovative PE processes was related to *capacity building*. New methodological and managerial capacities are necessary to organize innovative PE practices successfully, which in turn contribute to new governance capacities, such as anticipation, reflexivity and transdisciplinary mobilization of resources, and continuity, that we identified as the key capacities that help policy makers to dynamically manage complex issues in modern research and innovation policy systems. Conversely, we found that an inadequate capacity of the organizers of PE to manage complexities involved was the main obstacle of successful PE. Other major challenges included low motivation of the participants, technical problems, low political impact, inadequate funding, and cultural conflicts.

A positive vision of PE benefitting European R&I activities can be built around the idea of better involvement of actors. Better involvement occurs, when 'right people' are gathered together to address 'right issues' through 'right PE tools and methods'. While PE can be a rewarding experience in itself for the citizens, there is robust evidence of participant learning, indicating that through PE processes citizens can develop expanded understanding of the nature of the issues, as well

as an increased sense of political efficacy, or a sense of possibilities to act on behalf of one's interests rather than feeling helpless and alienated from the reality. Participation in collective problem solving efforts through PE processes helps citizens to develop new knowledge and skills that help them practically tackling even most challenging issues and problems (in *Let's do it!*, for example, citizens were instructed to clean their living environments from toxic waste materials, and they effectively did so in more than 100 countries). The possession of new skills and capacities, in turn, can contribute to a better quality of research as more people are able to provide their experience and expertise in collective problem solving efforts.

Unlike the infamous 'deficit model' (Irwin, 2001), where provision of 'correct information' on science is expected to develop more positive attitudes toward it, positive attitudes toward science, in our vision are expected follow from a better quality of research. By better quality we mean research that in addition to an academic quality has also ranks high in 'societal peer review' (cf., Funtowicz and Ravetz, 2003), and which in addition to scientific expertise, also mobilizes practical skills and societal capacities that are needed to effectively address societal challenges and challenging research issues.

Finally, we expect that a positive societal 'tune' can help to develop better R&I governance approaches, where public engagement, interaction and communication will remain key elements, as they have been defined in EU's RRI policies and its thematic priorities. – Following this logics, we have characterized a 'virtuous cycle' of PE, which is fundamentally our Vision of PE benefitting European R&I activities.

5 Discussion

Public engagement has become an important theme in the development of research and innovation activities in Europe and beyond. PE is very much 'the heart and spirit' of responsible research and innovation: it opens practices of research and policy to the publics and stakeholders; it involves ethical principles that highlight responsibility, (gender) equality, democracy, as well as effectiveness and efficiency of public decision making; it explores new ways to inform publics about prospects and risks of technoscience, and it mobilizes citizens' capacities to address related societal challenges. And Europe is not alone in this process. American Association for the Advancement of Science (AAAS), the

world largest general scientific society, has also prepared its own PE policies, which involves systematic work for the definition of appropriate visions and goals for PE, and consideration of relevant PE activities and inputs that are needed to reach desired outcomes from PE activity – outcomes such as publics' trust in and positive affect with science, better ability and comfort of scientists to convene relevant communities to deliberate scientific issues, and an increased motivation of research actors to conduce responsive research.[8]

In this paper we have contributed to a better understanding of the characteristics, trends, and impacts of innovative PE. By analysing a global sample of innovative PE processes, we have drawn lessons from the state-of-the-art in the field and developed conceptual models that are both intended to support evaluation of PE practices and put PE in perspective as an element of dynamic and responsible R&I governance. Such a work is necessary, since better understanding of innovative PE processes can contribute to a better capacity to develop European R&I governance and to develop better strategies to address societal challenges facing European societies.

Among the main observations are that there has been a shift of PE from traditional linear models of public communication and consultation, where dialogue between decision makers and the public is narrow and restricted, to multi-way public deliberations where such dialogues are intensive and influential.

Contrary some earlier studies, we found innovative PE to have truly versatile impacts, not only on research and innovation but also on environment, society, politics – and individuals. Prominent examples of the latter effects include political empowerment of youth and development of 'scientific citizenship', i.e. new understandings of the rights, duties and responsibilities of citizens in relation to science and technology (Irwin, 2001). PE stimulates such impacts by creating opportunities for mutual learning between scientists, stakeholders and members of the public.

Considering the different types of impact, we found that most of the impacts of innovative PE can be described as practical, while both normative and substantive impacts were recognizable, even though to a more limited extent. In sum, PE can provide new tools and approaches for the development and renewal of R&I governance in Europe and beyond. Innovative PE also expresses the spirit of both 'tentative governance' (Kuhlman and Rip, 2014) and 'dynamic governance'

(Guldbransen, 2014; Neo and Chen, 2007), where solutions are explored through pilots and experimentations rather than by introducing deductively driven or ready-made solutions. In addition to an entrepreneurial spirit of risk taking, we observed that innovative PE has contributed to new capacities that help research actors to better address societal challenges and complex governance problems. Such capacities included anticipation, reflection, transdisciplinarity and continuity, which we define as the key capacities of dynamic and responsible R&I.

The theme of public engagement has not been among the core themes among the innovation management community. With this paper we aim to contribute to a hybridization of discussions going on in the fields of innovation management and public engagement studies. Better capacities to anticipate, reflect and organize transdisciplinary research processes through PE are useful for managers of research and innovation processes and corporate social responsibility, as they help sensitizing decision making to the various needs of the society, and mobilize resources at a broader scale.

Our study has some implications on the practical design and evaluation R&I processes deploying PE:

First, we encourage research and innovation managers to openly explore the field of PE that is developing 'fast and furiously' through thousands of participatory processes developed and deployed each year on the themes of R&I. There are several toolkits that are freely available on the internet, which can support such familiarization and practical orientation.[9]

Second, we pay attention on the clear transition that has taken place in recent years. It is old-fashioned to think that PE is about communication of R&I, as it is more and more about a tool for coordinating heterogeneous networks, orchestrating systemic change and mobilizing resources more widely in society.

Third, the practice in the field of PE has become professional, and calls for institutional collaboration between consultancies focused on PE, think tanks, social science research units and NGOs. Evaluation of such practices has become solid basis for further developing and deploying these practices, and avoid some of the pitfalls underlying these activities. Methods such as the 'PE footprinting' approach can be useful in reducing some of the complexity and focusing attention on the essential aspects of PE activity. As for the evaluation, it should adopt a broad enough set of criteria that should be tailored to fit the context.

Finally, In order to facilitate the change of the research and innovation landscape, it is necessary to show different stakeholders the benefits of PE. There is also a need for moving from the focus on individual PE events to broader structural issues, where separate PE processes are better linked and embedded in the established structures of R&I policy. Gender policies and Social Corporate Responsibility (including its ISO standards) can provide positive analogies of the change ahead. Giants' steps to institutional transformation could be taken by changing funding criteria, introducing stronger policies, establishing new institutions and developing capacities supporting PE as part of dynamic and responsible governance of research and innovation.

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Notes

[1] www.pe2020.eu/
[2] http://www.rritrends.res-agora.eu/masis
[3] http://engage2020.eu/
[4] A system of organization that blends characteristics of chaos and order.
[5] Only G1000 and We the citizens (see, Table 1), were classified as 'one-way' processes, since they both emphasise and try to protect the political autonomy of the deliberative panels, for which reason they to pursue limited interactions with such actors who might compromise their autonomy. Even in those two cases, however, we can still recognize a tendency toward multiple rather than one-way flow of communications.
[6] European Commission has defined seven societal challenges that orient research programmes and projects funded under the Horizon2020 programme. These include the following challenges: A. Health, demographic change and wellbeing; B. Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy; C. Secure, clean and efficient energy; D. Smart, green and integrated transport; E. Climate action, environment, resource efficiency and raw materials; F. Europe in a changing world - inclusive, innovative and reflective societies; G.Secure societies - protecting freedom and security of Europe and its citizens. See, https://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges.
[7] Since it is in the interest of the project managers to promote their own activities, we expected there to be a positive bias in these reports. However, we found that these reports include also critical reflections on the challenges and obstacles met during different stages of the PE processes, which we consider reflect the honesty and learning orientation of these reports. In any case, we have found the reports to be highly useful for building a better understanding of the dynamics of PE innovation and the opportunities and challenges with current PE activities in Europe and beyond. Further, and to justify our strategy of data collection, it should be noted that for many recent PE projects, published reports were not available, and that the PE managers' reports therefore include inside knowledge that would not have been available through alternative research approaches.
[8] https://www.aaas.org/pes/what-public-engagement
[9] As part of the PE2020 project, we identified around 30 existing toolkits, and 18 of them were analysed in-depth (d'Andrea, 2015). The PE2020 Toolkit for Public Engagement with Science can be found at https://toolkit.pe2020.eu.